

To those who may be familiar with these plants the habit and appearance of members of the two taxa are noticeably different, although, as often happens in descriptive taxonomy, some of the differences are not easily stated in objective terms. In general, however, *Rudbeckia ampla* is a shorter, somewhat stouter plant with larger heads on fewer and stouter peduncles, the rays averaging somewhat wider. The disk corollas, achenes, and receptacular bracts are longer, the latter, commonly known as "chaff," furnishing distinctive characters that have been found to be important in the taxonomy of other species of the genus. Finally, it may be pointed out that the pappus of *R. ampla* is more coroniform, and the leaves are usually thicker and with different indument. In some specimens of *R. laciniata* the undersurface of the leaves tends to be less pubescent than in others, but almost all leaves show at least a few trichomes, particularly when viewed under the binocular microscope. It may be appropriate to note here that some published statements concerning *R. laciniata* are perhaps not as explicit as they should be. Unless modified, they may serve as a barrier to clarity of understanding of the plants described. For example, in the eighth edition of Gray's Manual the statements referring to the elongation of the "disk" of *R. laciniata*, as well as that indicating length of achenes, appear to be somewhat exaggerated, and are more nearly applicable to *R. ampla*.

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## PINES FROM NUEVO LEON, MEXICO

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The forest geneticist usually attempts to grow as many as possible of the different strains and species of trees in which he is interested. These may be used for two purposes: 1) to establish a breeding arboretum, the trees to be used as parents for desired crosses; 2) to establish, on a limited scale, trials of adaptability to local or special environmental conditions. Both purposes were in mind when the Texas Forest Service sponsored two pine collection trips to the state of Nuevo León, Mexico. In conjunction with drought resistance studies, species that can do well under severe conditions of heat and drought were especially sought.

The accrual of further knowledge of the taxonomic and evolutionary position of the Mexican pines was another objective of importance. The purpose of this paper is to report on the several pine species and their many intergrading forms found growing in one of the states of northeastern Mexico, Nuevo León. Although collections were not made at all points in the state, the three areas visited were intensively studied, and

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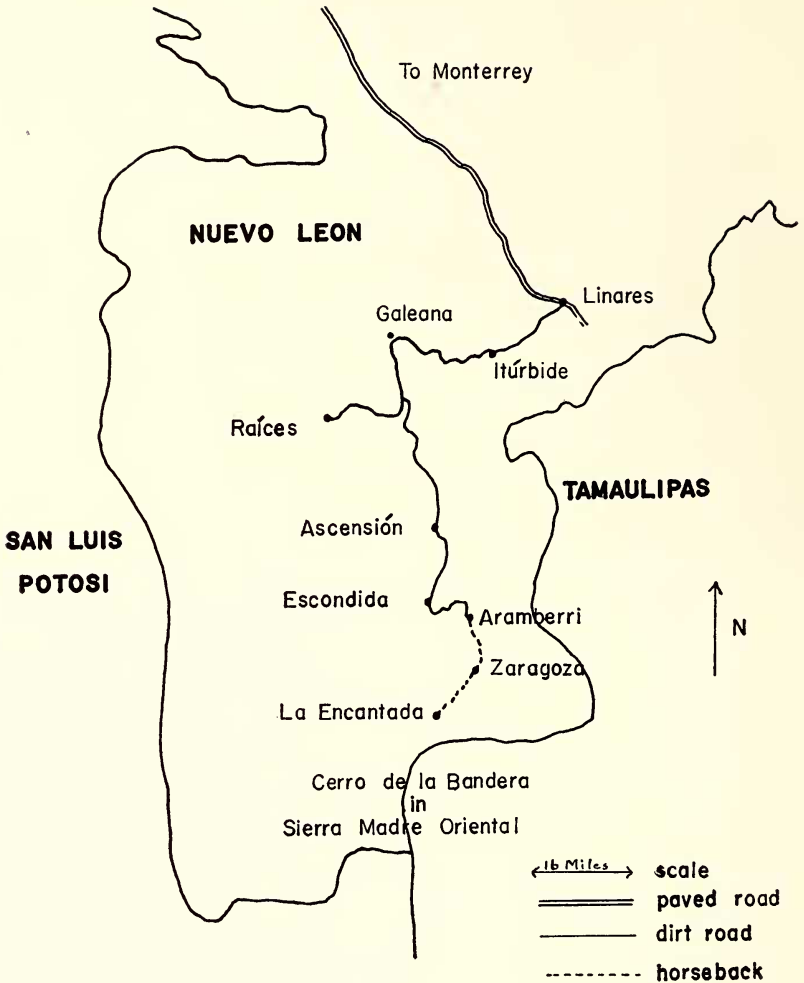


FIG. 1. Southern end of Nuevo León showing major area from which collections were made. The other two collecting areas were at more northerly points in the state.

complete records, specimens, and photographs were obtained for each species encountered.

The collection trips were the direct result of an invitation sent by Dr. E. A. Pequeño, Director, Instituto de Investigaciones Científicas, Universidad de Nuevo León. Though not a forester, Dr. Pequeño has an intense interest in the research upon and wise use of Mexico's forest resources, for he is fully cognizant of what their destructive exploitation will do to the economy of the country.



FIG. 2. Vicinity of La Encantada, illustrating the type and extent of the virgin forests in this area. A true fir (*Abies*) is in foreground.

The first trip was made in late September, 1954, with the senior author accompanied by Mr. Ruben Rocha, a Mexican student at Agricultural and Mechanical College of Texas, who acted as interpreter. This trip was preliminary in nature and little actual material was collected, because few pines bore cones that fall. However, many yearling cones indicated the possibility of a large cone crop for the following year. It was determined on this first trip that although a few species of pines matured their cones in September-October, the majority did not mature their cones until middle or late December or even in January.

Accordingly, the second trip was made late in December 1955. Both authors plus Mr. Chester Rowell, taxonomist from the Biology Department of the Texas A & M College and Mr. Rocha went on the second trip. The cone crop was plentiful on most species and abundant collections were possible.

The area from which most of the collections were made is in the extreme southern end of Nuevo León (fig. 1). As one goes into the mountains from Linares, the road which follows the stream bed rises sharply, going through the village of Itúrbide and then breaking out onto a plateau near Galeana. This unimproved road then proceeds in a southerly direction down the "plateau" through the towns of Ascensión, Aramberri, and (in 1954) to Zaragoza. From Zaragoza a trail leads up the mountain to the village of La Encantada, at an elevation of about 10,000 feet (fig. 2). Collections were made along this entire route wherever pines occurred,



FIG. 3. *Pinus arizonica* var. *stormiae* on nearly solid rock in a very dry area near Ascensión.

most, however, being made up the mountain from Zaragoza and around La Encantada.

The collecting area described above varied from nearly desert near Galeana, Itúrbide, and Ascensión (fig. 3), with less than 20 inches rainfall, to the well-watered mountain forests around La Encantada. The higher elevation collections around La Encantada were in virgin forests, which included conifers of the genera *Abies* (fig. 2) *Pseudotsuga*, and *Taxus*. This is a most beautiful region, lush with vegetation. It is very similar in character to the middle-high elevations on the west side of the Sierra Nevada of California. Access is difficult, due to the poor roads and the necessity for horseback travel over considerable distances. This limited the specimens that could be collected. As far as could be determined, the pines around La Encantada had not previously been collected and classified, though Martínez (1948) mentions pine specimens from the area near Zaragoza.

Small collections were made from two other areas, one on Chipinque near the city of Monterrey, and the other in the Sierra Picachos near the village of Sombretillo. This latter area is several miles to the east of the point where the Inter-American Highway from Laredo to Monterrey crosses the small range of mountains south of Sabinas Hidalgo.

All timbered regions at the lower elevations have been severely depleted. A crude method of bleeding for gum (oleoresin) is used extensively in the lowland areas, and in many cases so intensively and carelessly as to kill the trees (fig. 4). Fires and over-grazing have taken a huge toll and in



FIG. 4. Method of bleeding tree for gum (oleoresin). Note "cup" chopped in tree at base of peeled face.

many of the very scattered older stands, reproduction is lacking. There are indications in some areas that previously pine-covered land may degenerate to desert scrub if present treatment continues. Conversely the high mountain, virgin forests contain considerable overmature timber that is dying out. This could well be harvested if there were any method whereby the timber could be economically transported to markets.

In 1955, twenty-eight separate pine collections were made from the three areas visited. Each included: 1) ripe cones, up to a bushel from a single tree (these "green" cones were brought to Texas and the seed was extracted there); 2) a specimen fruiting branch, which contained mature cones, yearling cones, undamaged terminal bud, and typical foliage. These fruiting branches were pressed in the field; before this was done, however, a detailed study was made of their needles, buds, and other features, and colored photographs were taken to record foliage color, needle length and number, color and shape of unopened cone, color, position, and number of yearling cones, bud color, fuzziness, etc. In addition, needle bundles were preserved in formaldehyde-acetic acid-alcohol solution; these were later sectioned for the study of needle anatomy and morphology.

Current literature (Loock, 1950; Martínez, 1945 and 1948; Dallimore and Jackson, 1948) proved inadequate to the task of identification owing to the many recent changes in Mexican pine taxonomy and to the fact that the collections showed much intergradation. In order to make satisfactory species identifications of our collections, it thus became necessary to make a thorough analysis of all characters, including cross-sections of the needles, and then refer back to original sources in the literature of the genus.

#### SEEDLING CHARACTERISTICS

In all books referred to, there is a notable absence of reference to seedling characters. Such characters are of importance, especially since many of the Mexican species show a tendency to have delayed height growth, i.e., a semi-grass stage of development. This tendency towards a grass stage of development might well be a key diagnostic feature, as is true for the intensively studied "southern pines" in the longleaf-loblolly-slash pine complex. A tree with a true grass stage grows one to many years putting on only very little height growth, the needles being borne near the ground and appearing as a clump of "grass." A tree with a semi-grass stage makes only very little height growth the first year, but some stem is evident; in subsequent years it may, or may not, put on rapid height growth. The seedlings of the material collected varied from nearly a true grass stage to normal height growth (fig. 5).

Seedlings of all collections in this study have gone through one growing season in the nursery. Their characters will be discussed in the species list which follows.

#### PINUS SPECIES COLLECTED IN NUEVO LEÓN

Many species of pines, and their intergrades, were found in Nuevo León, with several species commonly growing completely intermixed.

Mexican pines do not display some of the usual differences held to be diagnostic of hard- or yellow-pines as contrasted with the soft- or white-pines. For example, many of the Mexican hard-pines contain five to seven or even more needles per fascicle, and five needles might be considered to be the rule rather than the exception. Conversely, the only true white-pine collected on this trip (*Pinus ayacahuite* var. *brachyptera* Shaw) had



FIG. 5. Seedlings of *Pinus hartwegii* (on left) showing tendency toward a modified grass stage; seedlings of *P. teocote* (on right) showing normal growth in height and a basal crook in stem similar to shortleaf pine (*P. echinata*).

many fascicles containing only three needles instead of the normally expected five.

The five-needle hard-pines were most difficult to classify. Especially so were six specimens that exhibited characters of *P. montezumae* Lamb., *P. montezumae* var. *lindleyi* London, *P. pseudostrobus* var. *estevezi* Martínez, and *P. durangensis* forma *quinquefoliata* Martínez. Their characters did not fit any taxon completely, and after careful study the conclusion was drawn that they were intermediate or intergrading forms. Such intermediacy might well be called the rule here, especially for the five-needled pines. Both Loock (1950) and Martínez (1948) call attention to the intergrading forms and the complexity of the classification.

Four trees were found that had characters sufficiently dissimilar to previously described species so that they could not be definitely classified. These are included at the end of the species list. Three of the pine species in the list which follows have not been previously reported growing in the state of Nuevo León (Loock, 1950, and Martínez, 1948).

In addition to the pines, collections were also made of the genera *Abies*, *Pseudotsuga* and *Taxus*. The authors at first thought that *Taxus* had acquired a new distribution record, until it was found that Hernández *et al.* (1951) reported *Taxus* in the neighboring state of Tamaulipas. Many different oaks (*Quercus*) were observed, as well as other hardwoods such as Madroño (*Arbutus*). This is an area rich in many forms of vegetation and an extended collection trip would be most worthwhile.

*PINUS AYACAHUITE* var. *BRACHYPTERA* Shaw. This species had intermediate characters, in many ways closely resembling *P. reflexa* Engelm. Needles were predominantly in fascicles of five, with many fascicles of 3, 4, and 6 being present on mature trees. Collections were made near La Encantada at an elevation of approximately 10,000 feet. This pine was growing among hard-pines, *Abies*, *Pseudotsuga*, and *Taxus*. The trees were very large on the better sites. Cones mature early (October and November) so no seeds were obtained.

*PINUS ARIZONICA* var. *STORMIAE* Martínez. Several collections of this species were made, from near Ascensión to the area around Galeana, at elevations from 5,000 to 6,000 feet. Classification was accurate. This species was growing on extremely rugged sites, with low rainfall. One collection was made on nearly pure calcareous soil, with little other vegetation being present. Seedlings, as well as mature trees, all had needles in fascicles of three. All seedlings had delayed height growth, a semi-grass stage of development.

*PINUS CEMBROIDES* Gord. Collections were made near Ascensión, at elevations around 5,000 feet; they were easily classified. This species was very widespread. Needles were mostly in fascicles of 2, a few fascicles having 3. Cones mature early and no seeds were collected.

*PINUS HARTWEGII* Lindl. Several collections were made of this species, most of which were easily classified. One collection had characters very similar to *P. rudis*. All collections were made near La Encantada, at elevations around 10,500 feet, in nearly pure stands. Needles were predominantly in fascicles of 5, some of 4. Seedlings all had their needles in fascicles of 3, and had a definite semi-grass stage (fig. 5). The seedlings looked somewhat like those of *P. pseudostrobus*, but were coarser.

*PINUS PSEUDOSTROBUS* Lindl. Two collections of this species were made, one fitting the classification well, the other having affinities with *P. hartwegii*. Collection was near La Encantada at elevations around 10,000 feet. These trees were growing in a mixed pine and fir stand, just below the pure *P. hartwegii*. Needles were mostly in fascicles of 5, with some of 6 and 7 present. Seedlings had needles in fascicles of 3, 4, and 5, and had a definite semi-grass stage similar to *P. hartwegii*.

*PINUS PSEUDOSTROBUS* var. *ESTEVEZI* Martínez. This species was collected only west of Iturbide at an elevation of 5,000 feet. It was fairly easily classified, though all characters did not exactly fit. It was growing under relatively droughty conditions. Needles were in fascicles of 5, with some 4 and 6. Seedlings had needles in fascicles of 5. Unlike *P. pseudostrobus*, height growth of the seedlings was normal.

*PINUS PSEUDOSTROBUS* forma *PROTUBERANS* Martínez. It was difficult to classify this species accurately since no foliage was collected. Cones were collected at dusk from three trees, all appearing to be the same until cones were closely examined. Two of the trees remain unclassified, having needle anatomy like *P. hartwegii*, foliage like *P. rudis*, and cones similar to *P. pseudostrobus* var. *estevezi*. The third tree had cones exactly like *P.*



*pseudostrobus* forma *protuberans*. Collection was made near Ascensión, at an elevation of 6,000 feet. Seedlings had a semi-grass stage, with needles in fascicles of 3, 4, and 5. This species has never been reported in Nuevo León, only from the more southern states.

PINUS MONTEZUMAE Lamb. Several collections were made of this species, and classification was from very exact to doubtful. Two collections were very similar to *P. montezumae lindleyi* and also to *P. pseudostrobus*. Specimens were obtained near Zaragoza, Escondida, Ascensión, Itúrbide, and in the Sierra Picachos near Sombreretillo, ranging in elevation from 3,500 to 6,000 feet. Needles were in fascicles of 5, with an occasional 4. The needles of seedlings were in fascicles of 3, 4, and 5, the predominant number varying from tree to tree. Seedlings had extra long needles and had normal height growth (no grass stage). This was different from seedlings obtained from seed previously sent to us as *P. montezumae*, all of which had a pronounced grass stage.

PINUS MONTEZUMAE var. LINDLEYI Loudon. Classification of this species is only partially satisfactory, some characters not fitting too well. It was collected near Zaragoza at 5,000 feet elevation. Needles were in fascicles of 5, with some of 4. Seedlings had needles in fascicles of 5 and had normal height growth. This species has not previously been reported in Nuevo León, only from the states to the south, including Hidalgo, Vera Cruz, and Querétaro.

PINUS TEOCOTE Schl. and Cham. Of the several collections of this species, only one was in doubt, because of the needle anatomy. Collections were made near La Encantada, Ascensión, and at Chipinque, near Monterrey. Elevations ranged from 4,500 feet to 10,500 feet. Needles were short, always in fascicles of 3. Seedlings had all their needles in fascicles of 3, and had normal height growth (fig. 5). All had an unusual crook at the base of the stem, similar to that found in shortleaf pine (*P. echinata* Miller). Just as for *P. montezumae*, seed sent to us under the name of *P. teocote* had a grass stage, while none of our own collections showed this feature.

PINUS DURANGENSIS forma QUINQUEFOLIATA Martínez. Three collections were made of this species, none of which were classified with exactness. Characters were found similar to *P. pseudostrobus estevezi*, *P. montezumae* and *P. pseudostrobus*. This species has not previously been reported in Nuevo León, being found to the west in the states of Chihuahua and Durango. Our collections were made at La Encantada, Chipinque, and Sombreretillo. Needles were in fascicles of 5, with a few 4, and occasionally 6. Seedlings from two of the trees had needles in fascicles of 5, while one (from Sombreretillo) had them of 3, 4, and 5. Seedlings were tall (no grass stage), with long needles.

PINUS RUDIS Endl. One poorly classified collection was made of this species, the tree having characters like *P. montezumae lindleyi* and *P. pseudostrobus*. Collection was made at La Encantada, at 9,500 feet elevation. Needles were in fascicles of five. Seedlings were tall and had needles in fascicles of three, four, and five.

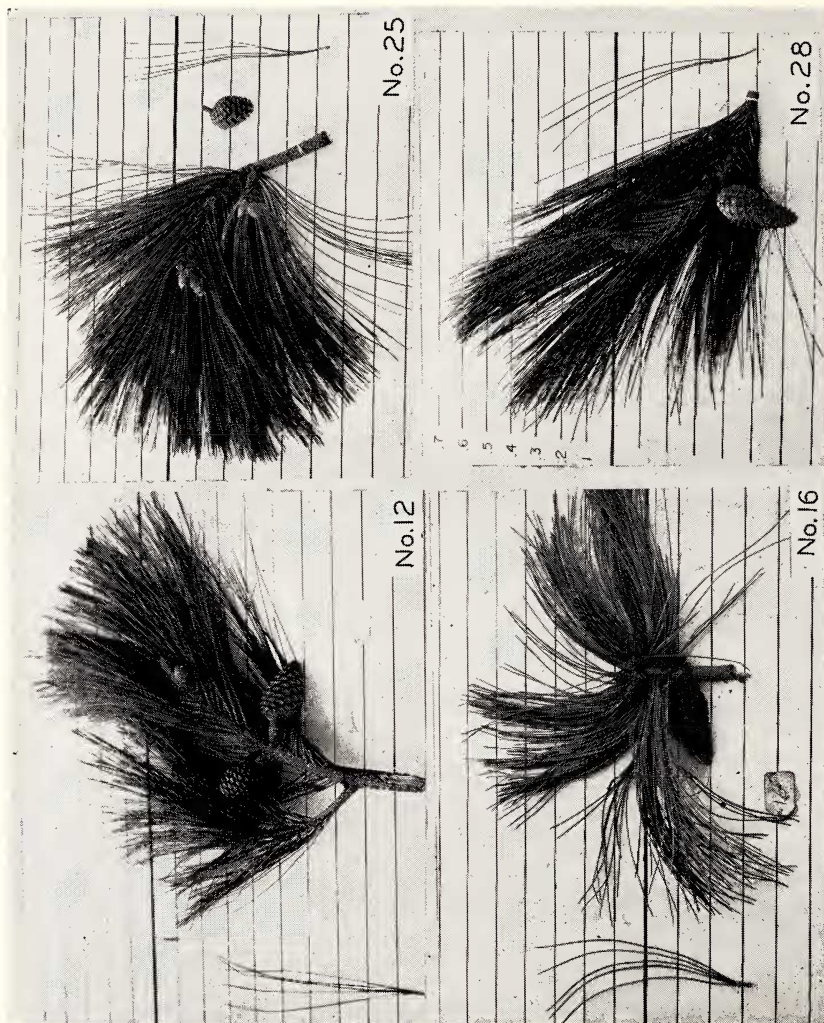


FIG. 6. Cones and foliage of unclassified trees, numbers 12, 16, 25, 28. Background board in 0.1 foot units.

The following *Pinus* collections from Nuevo León remain unclassified:

TREE No. 12 (fig. 6). Growing on a very dry site near Ascensión, with cacti and a few xerophytic shrubs. Surprisingly vigorous for a tree growing on such a poor site. Foliage with needles all in fascicles of five, about 20 cm. long, thin, flexible, slightly drooping; resin ducts two to four; endodermal outer wall thickened; hypodermis with moderate intrusions into chlorenchyma; two vascular bundles touching but distinct. Cone 8 cm. long; peduncle about 2 cm. long; color greenish black when unopened, changing to dark brown with drying; apophysis strongly keeled, somewhat reflexed on dorsal part of cone; umbo very small, prickle not sharp, not deciduous. Seedling with needles in fives, thin; having normal height growth.

TREE No. 16 (fig. 6). Collected only in one small valley above Zaragoza, growing intermixed with oaks at 6,000 feet elevation. Given by us the name "blue pine" due to the very bluish color of the foliage. Appearing to belong to the *P. rudis*-*P. hartwegii* complex, with intermediate characters. Foliage with needles predominantly in fives, about 18 cm. long, very stiff, twisted, glaucous blue-green; resin ducts seven to ten, medial; endodermal walls thin; hypodermis intruding slightly into chlorenchyma; two vascular bundles separated by several cell thicknesses of transfusion tissue. Cone about 10 cm. long, purplish black when unopened, olive brown when dried, asymmetric; apophysis flat to somewhat raised; umbo grey, sunken, very small. Seedling with needles in bundles of three, coarse; with modified grass stage.

TREE No. 25 (fig. 6). Growing in creek bottom, very rocky, Sierra Picachos, near Sombreretillo. Foliage with needles in threes, fours, and fives, predominantly fives, about 23 cm. long, moderately heavy, drooping, blue-green; resin ducts three to six, medial; endodermal outer walls thickened; two vascular bundles close together, not distinct; hypodermis very thick with small intrusions. Cone (old, hanging on tree; no fresh cones) about 5 cm. long; peduncle about 1.5 cm. long; apophysis raised with flat face, slightly keeled; umbo flat to sunken. Seedling none.

TREE No. 28 (fig. 6). From Sierra Picachos, near Sombreretillo. Needle number distinguishing this tree from *P. durangensis* and similar species. Foliage with needles predominantly in threes, few fours and fives, around 25 cm. long, somewhat pendent, moderately thin; resin ducts three and four, medial and one internal; endodermal outer walls variable, thick to slightly thick; two vascular bundles touching but distinct; hypodermis thick, with considerable intrusions. Cone about 9 cm. long, black to purplish green unopened, drying to light olive brown, somewhat asymmetrical; apophysis on dorsal side considerably reflexed, strongly keeled; umbo raised, ashy gray, with recurved, short, stout prickle. Seedling with needles in threes and fours, occasionally fives, thick; with normal height growth.

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The authors wish to thank all those who made these trips to Mexico possible and profitable. Dr. E. A. Pequeño is to be especially recognized for suggesting the trips, for accompanying the authors on both trips, and for helping to defray expenses incurred while in Mexico. He is to be commended for his interest in the natural resources of Mexico. We hope his conservation efforts will be successful.

Mr. Erasmo Cerda of Aramberri hosted both collection parties, and supplied housing, food, horses and guides necessary for the trip to La Encantada.

Mr. Chester Rowell helped considerably on the second trip with his knowledge of both the Mexican flora and language, as well as helping greatly on the photography.

The Medellín brothers acted as guides from Zaragoza, and welcomed the parties to La Encantada. Their help and friendliness certainly aided in making the North American visitors feel welcome in Mexico.

The several others that went as helpers or students on the trips were indeed appreciated. Everyone present contributed something to help enrich the value of the collections.

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